REMARKS

The above amendment and these remarks are responsive to the Office action of Examiner Joshua A. Kading, dated 10 Mar 2004.

Claims 1-35 are in the case, claims 1, 2, and 21 allowed, and claims 16 and 17 objected to as depending from rejected claims, but otherwise allowable.

Claims 25-35 have been newly added as program storage device claims generally corresponding to method claims 2-12, respectively.

Drawings

Objection has been made to drawing Figures 7 and 8A.

Applicants submit herewith replacement drawing Figures 7 and 8A, making the changes suggested by the Examiner, and request that they be entered in the case.

Specification

Objection has been made to the specification.

Applicants have amended the paragraph at Page 1, line 5, page 18, line 8, and page 42, line 15 to provide the serial numbers.

Claim Objections

Claims 1, 3, 5, 6, 7, 9, 11, 13, 16, 17, 18, 19, 20, 21, and 22 have been objected to for various informalities.

Applicants have amended these claims to correct the informalities noted by the Examiner.

35 U.S.C. 112, first paragraph

Claims 3-10 have been rejected under 35 U.S.C. 112, first paragraph, as failing comply with the enablement requirement.

Before addressing the Examiner's rejection, applicants note that the invention was developed, discovered, and created using spreadsheets. That was how it was initially understood and how it was understood at the time of the patent writeup. Given time to reflect on what was discovered, it is evident that a full algebraic description may be a better representation than an equivalent geometric and spreadsheet-based description, but that those of ordinary skill in the art would be able to derive such from the material provided in the specification as filed. Some of that derivation was completed in the course of preparing the specification. Thus, in the patent application, the algebraic formulas which were derived and are provided come after the spreadsheet and geometric descriptions - which was the actual order of discovery.

Those of ordinary skill in the art will appreciate the equivalence of the spreadsheet/geometric representation to the algebraic representation presented hereafter in response to the Examiner's rejection under 35 U.S.C. 112, first paragraph.

Calculation of Discrete Utilization (p)

(Claims 3 and 4)

With respect to claims 3 and 4, the Examiner asserts that there is no clear specification of how to calculate p (i.e., utilization) from Tw and σTw (i.e, sigma Tw). (Office Action, page 4.)

Applicants respectfully traverse.

First, the patent application states that the ratio of Tw and σTw provides a unique solution for p. (Specification, page 31, lines 5-11.

Second, the patent application specifies a spreadsheet derivation of p from Tw and σTw using a table lookup from a table derived from Tw and σTw. (Specification, Figure 7, page 24, line 3-21 and page 31, line 19 to page 32, line 12.)

Third, from the information provided in the specification, the formula for p expressed in terms of Tw and σTw may be derived algebraically as:

$p = 2Tw^2 / (\sigma Tw^2 + Tw^2)$.

Material from the specification which supports the derivation of p includes the following:

"By queuing theory, Tw and σTw have the following values:

$Tw = p * Ts / (1 - p)$

$\sigma Tw = \text{square root } (p * (2 - p)) * Ts / (1 - p)$.

"Both Tw and σTw are easily observed and calculated from probative samples j...q. Dividing Tw by σTw thus gives a value that is equal to p / square root (p * (2 - p)). Since a non-negative real number is equal to a function of a single variable (i.e., p) which is monotone increasing for non negative values, the solution is obtained uniquely algebraically or by using chart values for p = 0 through .99, which are decimal representations of 0% through 99% utilization, to solve for p by approximation." (Specification, page 30, line 21 to page 31, line 11.)

Based on the above, the derivation of the relationship

may proceed as follows.

The specification provides a spreadsheet example (Figure 7) for solving by approximation, as noted above.

The algebraic formula for exact derivation is implied in the text above. The issue is to find observable values from which discrete utilization (the Greek rho, symbolized as "p" above) can be calculated. The problem with accomplishing this is that if one records ping times, one can easily determine Tw and sigma Tw. However, the formulas for these, as stated in the above quote, involve ratios of utilization and service time (Ts). So any equation for Tw or sigma Tw has two variable unknowns, and no unique solution. The solution for removing the unknown variable Ts and creating an equation that can be solved is described in the text above, namely, dividing Tw by sigma Tw (or vice versa). This removes Ts (service time for the network's average message, a value which is at this point of the analysis unknown), and leaves us with an easily solvable equation for p (utilization). Here's how it works. From text in the specification at page 31, lines 1-2:

$$Tw = p * Ts / (1 - p)$$

$$\sigma Tw = [\text{square root } (p * (2 - p))] * Ts / (1 - p).$$

And as described above taking the ratio of Tw to Ts (i.e. dividing) we remove Ts from the equation, leaving us free to solve for p. From text in patent application, at page 31, line 5:

$$Tw / \sigma Tw = p / [\text{square root } (p * (2 - p))].$$

As is set forth immediately below, this enables solving for p algebraically, and deriving:

$$p = 2\, Tw^2 / (\sigma Tw^2 + Tw^2)$$

Thus p is expressed purely as a function of Tw and σTw, which are observable values.

The algebraic derivation is as follows of p:

$$Tw / \sigma Tw = p / [\text{square root } (p * (2 - p))]$$

$$\sigma Tw / Tw = [\text{square root } (p * (2 - p))] / p$$

$$\sigma Tw^2 / Tw^2 = (2 - p) / p$$

$$\sigma Tw^2 / Tw^2 = 2 / p - 1$$

$$\sigma Tw^2 \ / \ Tw^2 \ +1 = 2 \ / \ p$$

$$(\sigma Tw^2 \ / \ Tw^2) \ + (Tw^2 \ / \ Tw^2) \ = 2 \ / \ p$$

$$(\sigma Tw^2 + Tw^2 \ ) \ / \ Tw^2 \ = 2 \ / \ p$$

$$2 \ Tw^2 \ / \ (\sigma Tw^2 + Tw^2 \ ) = p$$

The explicit equation for utilization is unique and solved for by dividing Tw by sigma Tw. This removes one of the two unknowns and enables a unique solution for the variable p from the observable Tw and sigma Tw.

Applicants point out that performing the algebra of this derivation from the formulas for Tw and σTw is not the key point. Rather it is the recognition (which is set forth in applicants specification as noted above) that there is an algebraic relationship between Tw and σTw from which p can be unambiguously derived and then, as included in the patent application, recognition of the fact that taking the ratio of Tw and σTw allows for the unique solution for p. This allows calculation of the network's utilization from observable samples of work performed by the network (Tw and σTw being easily derived from observations of pings of a given size). This is novel because prior use of queuing theory involved knowing the state of the network to derive how work would be performed by that network. The technique

described in this patent application is new and valuable because it does the converse; it derives the state of the network (in this instance, its utilization) from observations of how work is performed by the system.

Applicants urge that the rejection of claims 3 and 4 under 35 U.S.C. 112, first paragraph, be withdrawn.

Derivation of Capacity, Latency, and Current Utilization from Test Packets (Claims 5 and 6)

With respect to claims 5 and 6, the Examiner asks "How are these [capacity, latency, current utilization] 'deduced' from the test packets?" and then asserts "The specification is silent on equations or calculations using test packets to determine capacity, latency, and current utilization of the capacity." (Office Action, page 5.)

Applicants direct the attention of the Examiner to the material beginning at page 42 of the specification under the heading "Formulas". In this section, a stepwise algebraic description of the process is given.

First, the derivation of speed from the samples is performed by taking the ratio of the difference in bits between best observed short and long ping samples from the total set of samples, as is set forth in the following:

> "**Network Discrete Speed** (this is the end to end rate at which datagram traffic will be carried across the network if the network is empty of other traffic and there is no retransmission required.)
>
> Formula:
>
> network discrete speed = (long packet bits - short packet bits) / (best long time - best short time)"

(Specification, page 44, lines 3-9.)

Second, the latency of the network is calculated from the discrete speed by subtracting packet serialization (which is easily derived from discrete speed) from the packet's total round trip time, for the best observed packet of a given length. For a packet of b bytes in length the following text, describing Figure 6, provides the precise

algebraic formula as well as a geometric depiction of the derivation of latency:

> "Network latency, segment (e,a), is determined from samples j through q and samples k through r as follows. Samples j and k determine the slope of segment (e,l), whose inverse represents the network's discrete speed. Segment (b,j) represents the total response time for transmission and receipt of a packet of b bytes that experiences no network queuing. Therefore (b bytes * 8) / network discrete speed = Ts for b bytes, which is segment (f,j) on the chart. Subtracting Ts from total response time gives latency; that is, (b,j) - (f,j) = (b,f). In this example latency is calculated from discrete speed and short packet response time. Discrete speed and large packet response time could similarly be used to calculate latency, as could averaged large and small packet response time and size together with discrete speed."
>
> (Specification, page 28, line 13 to page 29, line 6.)

Third, the network's discrete utilization is solved for

in the patent application by a table lookup in a spreadsheet, and based on the ratio of Tw and σTw. This is described with respect to Figure 7, for example, as follows:

> "In step 218, by comparing (that is, determining the closest match of) the network's ratio of Tw to σTw derived in step 206 with all or representative ratios of U to the square root of (U * (2-U)) for all or representative possible values of U (from 0% to 99%) the value of U for the network is determined. The example of Figure 7, this closest comparison occurs at cells F29 and F30."

(Specification, page 35, line 16 to page 36, line 1.)

(The following formula, as derived above with respect to the rejection of claims 4 and 5, gives the same result:

$$p = 2\ Tw^2 \ / \ (\sigma Tw^2 + Tw^2) \ ).$$

Applicants urge that the rejection of claims 5 and 6 under 35 U.S.C. 112, first paragraph, be withdrawn.

Determination of Number of Messages

Queued Per Network Hop Count

(Claims 7-10)

With respect to claims 7-10, the Examiner asks "How are said test packets used to determine a num ber of messages queued per network hop count... the specification is silent on how the test packets are used in this calculation?

Applicants respond as follows. As is described in connection with the chart of Figure 6, messages queued per network hop is derived from hop count and utilization. Hop count is derived by taking the ratio of streaming speed to discrete speed, as follows:

> "Hop count, spreadsheet cell J9, represents the minimum possible number of actual physical hops in the end to end network. The hop count value is derived by dividing the throughput speed by the discrete speed. This value is then multiplied by two if the throughput speed was calculated with echo packets and the network is full duplex, which is represented the spreadsheet

example. Geometrically, this calculation would be represented in the chart of Figure 6 by dividing the inverse of the slope of (e,i) by the inverse of the slope of (e,l) and multiplying the result by two."

(Specification, page 27, lines 1-10.)

The use of test packets to derive discrete speed was described above in response to the rejection claims 5 and 6. The use of test packets to derive streaming speed is described in explanatory text for Figure 6, as follows:

"The dashed line segment (e,i) represents the streaming speed of the network. Herein, this speed is calculated by transmitting a burst of (e.g., 10) packets across the network, calculating the time from the receiver's receipt of the first to the last, dividing the total number of bytes received by the time, and multiplying by 8 to get the bits per second throughput speed of the network. This value is cell J7 in the spreadsheet."

(Specification, page 25, line 23 to page 26, line 7.)

(<u>In addition to</u> the above description of the derivation of streaming speed in the present application, an algebraic description is given in copending application Serial No. 09/746,183, the teachings of which have been incorporated by reference at page 1 of the present application.)

Applicants urge that the rejection of claims 7-10 under 35 U.S.C. 112, first paragraph, be withdrawn.

35 U.S.C. 112, second paragraph

Claims 5, 11-12, 18, and 19 have been rejected under 35 U.S.C. 112, second paragraph, as failing to comply with the definiteness requirement.

With respect to claim 5, the claim has been amended to clarify the intended use of the word "responsive".

With respect to claims 11-12, the claim has been amended to clarify that it is directed to discrete utilization.

With respect to claims 18-19, the claims have been

amended to clarify that these claims are apparatus claims (by recited "module", which is understood to be hardware).

With respect to claim 19, the meanings of the terms "change in network traffic" and "network response time service level" are explained at page 11, line 10 to page 12, line 3, as follows:

> "Service level and capacity planning routine 36, responsive to the skilled use of routines 32 and 34, provides comprehensive "what-if" network planning facilities; calculation of the increase (or change) in network traffic before network response time service level is compromised; calculation of the additional file load capacity of the network, which is the additional file load before response time is compromised (for both prioritized and non-prioritized network cases); and determination of tuning recommendations for recommended window size for file transfer to fill remaining capacity (both respective and irrespective of maintaining response time service level, and for both prioritized and non-prioritized cases). In addition, routine 36 performs comprehensive what if end processor planning for the

end systems with respect to processor-bound, I/O-bound, and general transactions."

These terms are well understood by those of ordinary skill in the art.

With respect to claim 22, applicants have amended the claim to clarify that it relates to a computer program embedded on a computer readable medium.

Applicants request that the rejection of claims 5, 11-12, 18, and 19 under 35 U.S.C. 112, second paragraph, be withdrawn.

35 U.S.C. 101

Claims 18-20 have been rejected under 35 U.S.C. 101 as drawn to non-statutory subject matter.

Applicants have amended the claims as suggested by the Examiner so as to more clearly recite the computer readable medium.

Applicants request that the rejection of claims 18-20 under 35 U.S.C. 101 be withdrawn.

35 U.S.C. 102

Claim 13 has been rejected under 35 U.S.C. 102(e) over Kim et al. (U.S. Patent 6,219,704 B1).

Applicants traverse.

Kim is not using average wait time (Tw) and a standard deviation of wait time (σTw), as is set forth in the claim.

Rather, Kim is using the measure of total end to end delay (Not Tw but, rather, Ts + Tw + propagation delay + device latencies) and its standard deviation.

One skilled in the art will recognize that the value of the standard deviation of the end to end delays experienced for packets of a particular size will be equivalent to σTw. However, because the end to end delay value differs markedly from Tw, which is what is used in the patent application now under examination, Kim is covering a separate matter.

Notably, Kim neither mention nor uses anything like the ratio between Tw and σTw which is employed in this patent application, and Kim never mentions or measures a calculation of network utilization. Moreover, Kim does not account for packet loss in any calculations (nor is it mentioned). The application under consideration fully accounts for instances of packet loss.

Kim is predicting the delay packets sent into a network will experience. Kim is not deriving the characteristics of the network that cause that delay. Applicants' patent application does this. In other words, the present application uses samples of work performed by the network to determine the network's propagation and device latency, the network's speed, and the network's utilization. Kim does none of this. Moreover, Kim's patent fails to distinguish between the network's conversational and streaming speed and conversational and streaming utilization, and even fails to distinguish between streaming applications and conversational applications. The present patent application makes all of these distinctions and provides a means for discovering their values by analyzing how the network performs when samples are introduced into it.

Applicants urge that claim 13 be allowed.

35 U.S.C. 103

Claim 14 has been rejected under 35 U.S.C. 103(a) over Kim et al. in view of applicants' admitted prior art.

Claim 14 depends from claim 13, and is distinguished from Kim et al. as previously described. The alleged "admitted prior art" does not teach the use of average wait time (Tw) and a standard deviation of wait time (σTw) as set forth in claim 13.

Claim 15 has been rejected under 35 U.S.C. 103(a) over Kim et al. in view of McKee et al. (U.S. Patent 5,477,531).

Claim 15 also depends from claim 13, and is distinguished from Kim et al. as previously described. The Examiner relies on McKee for its teaching of "two way echo packets". Thus, neither Kim nor McKee teach the use of nor suggest singly or in combination average wait time (Tw) and a standard deviation of wait time (σTw) as set forth in claims 13 and 15.

Applicants urge that rejections of claims 14 and 15 under 35 U.S.C. 103(a) be withdrawn.

Allowable Subject Matter

Claims 16 and 17 have been objected to as being dependent upon a rejected base claim (13), but otherwise allowable.

Applicants have submitted claims 23 and 24, corresponding respectively to claims 16 and 17 and including all of the limitations of base claim 13.

Claims 1-2 and 21 have been indicated as allowable.

SUMMARY AND CONCLUSION

Applicants urge that the above amendments be entered and the case passed to issue with claims 1-35.

The Application is believed to be in condition for

allowance and such action by the Examiner is urged. Should differences remain, however, which do not place one/more of the remaining claims in condition for allowance, the Examiner is requested to phone the undersigned at the number provided below for the purpose of providing constructive assistance and suggestions in accordance with M.P.E.P. Sections 707.02(j) and 707.03 in order that allowable claims can be presented, thereby placing the Application in condition for allowance without further proceedings being necessary.

Sincerely,

H. R. Gail, Jr. et al.

By

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Date: 10 June 2004

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ROW	A PING DELTAS	B SAMPLE
6	0	1
7	0.00092	2
8	0.00097	3
9	0.00191	4
10	0.00347	5
11	0.00452	6
12	0.00536	7
13	0.00632	8
14	0.00729	9
15	0.01133	10
16	0.00421	Tw
17	0.00333	σTw

J	
383000	OBSERVED LINE SPEED
61476	OBSERVED DISCRETE SPEED
3.1150368	HOP COUNT (TWO WAY)
0.0013513	OBSERVED Tw FOR HOP COUNT
0.0033311	OBSERVED σTw

AH

	A	B	C	D	E	F	G	
25	0.33	0.34	0.35	0.36	0.37	0.38	0.39	MAXU
26	0.985	1.030	1.077	1.125	1.175	1.226	1.279	MAXM
27	0.316	0.331	0.346	0.361	0.377	0.394	0.410	MINM
28	0.24	0.25	0.26	0.27	0.27	0.28	0.29	MINU
29	0.369	0.377	0.384	0.391	0.398	0.405	0.413	RATIO 1
30	0.406	0.406	0.406	0.406	0.406	0.406	0.406	RATIO 2

32	0.33	DISCRETE UTILIZATION (AVERAGE)
33	0.0013513	Tw
34	0.495	MESSAGES ON QUEUE
35	383000	SPEED THIS HOP
36	1045	NETWORK AVERAGE MESSAGE SIZE

FIG. 7

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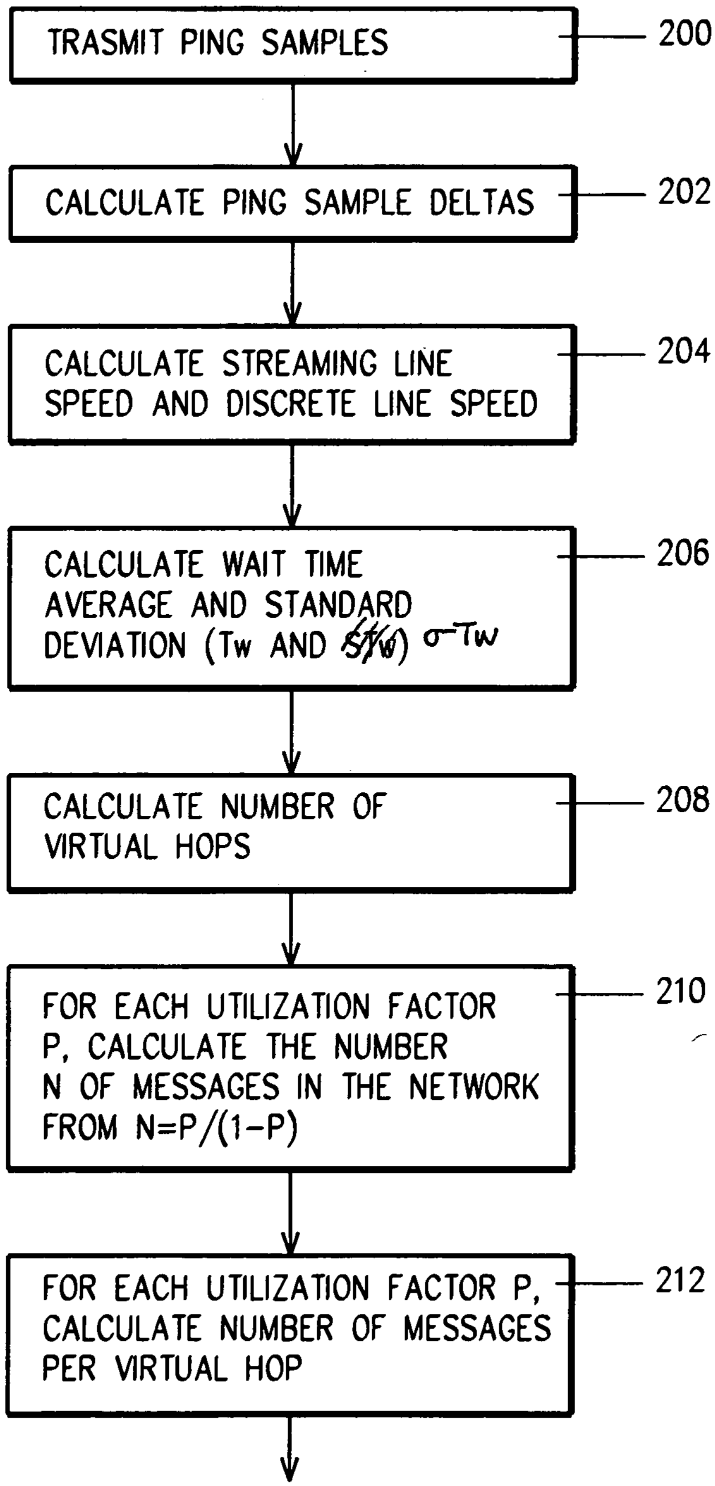

FIG. 8A